



Year 12 IB Chemistry
3rd Term test
Option D (60 minutes)

Name and surnames _____

Date _____

Marks. A__/16 B__/14 C__/10

1. Pharmaceutical products can often undergo up to 12 years of development and testing before being sold commercially. Define the following terms in relation to this process.

a. LD50

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(A1)

b. Therapeutic window

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(A1)

c. Bioavailability

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(A1)

2. Aspirin is one of the most widely used drugs worldwide.

a. It is used as both a mild analgesic (painkiller) and also as a prophylactic.

i. Explain how a mild analgesic works.

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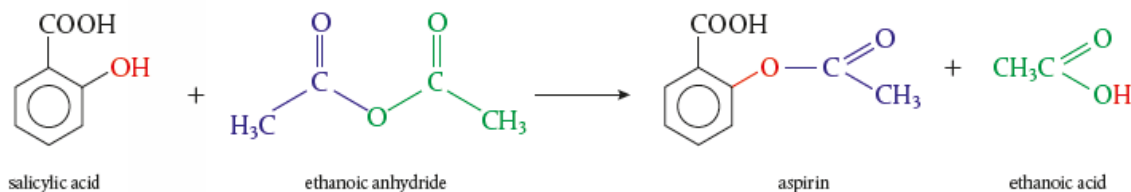
(A2)

ii. Explain what is meant by “prophylactic” and give one example of a physiological effect in this context.

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(B1)

- b. Aspirin is produced via a reaction between salicylic acid and ethanoic anhydride as shown below.



- i. Excluding the benzene ring, state the 2 functional groups found in aspirin.

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(A1)

- c. The final stage of the synthesis is purification to remove impurities from the white product obtained.

- i. State the name of the purification process commonly used.

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(A1)

- ii. The literature value for the melting point of aspirin is 159 °C. If the experimental value was seen to be 151 °C, calculate the % error between the two values.

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(C1)

3. The term “dyspepsia” is used to describe feelings of pain and discomfort in the upper abdomen. These can include heartburn, indigestion and ulceration. There are a variety of drugs which can be used to treat dyspepsia.

- a. One such example is Ranitidine (Zantac).

- i. Explain how Zantac reduces acid secretion in the stomach.

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(A2)

- ii. Use the data booklet to state 1 functional group shared by both Zantac and histamine.

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(A1)

- b. Antacids are a common treatment and often contain metal carbonates such as Na_2CO_3 .
- i. Write a balanced equation between sodium carbonate and hydrochloric acid.

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(A1)

- ii. Describe 1 problem associated with the use of carbonates and hydrogencarbonates as antacids.

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(A1)

- iii. Magnesium hydroxide and aluminium hydroxide can also be used as antacids. Show which would neutralise the greater amount of hydrochloric acid if 0.3 moles of each are used.

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(C2)

- c. The Henderson-Hasselbach equations found in the data booklet allow use to calculate the pH of buffer solutions.
- i. 100 cm^3 of a buffer is prepared which contains $0.100 \text{ mol dm}^{-3}$ butanoic acid and $0.200 \text{ mol dm}^{-3}$ sodium butanoate. (the pK_a for butanoic acid can be found in the data section)

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(C2)

- ii. What is the change in pH when 2.00 cm^3 of $0.100 \text{ mol dm}^{-3}$ HCl is added to this buffer?

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(C2)

4. The antiretroviral drugs Tamiflu (oseltamivir) and Relenza (zanamivir) are found in Section 37 of the data booklet. State the the 3 funtional groups that they have in common.

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(B2)

5. Unstable nuclei undergo radioactive decay by emitting one of several types of radiation.
- Thorium-234 is formed by the alpha decay of uranium. Use the selected section of Section 6 to write a nuclear equation for this process.

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(B2)

- Thorium-234 can undergo beta radiation. Complete the following nuclear reaction.



(B1)

- The isotope radium-226 has a half-life of 1620 years. Calculate the rate constant for the decay of this isotope using the relevant equation from the data booklet.

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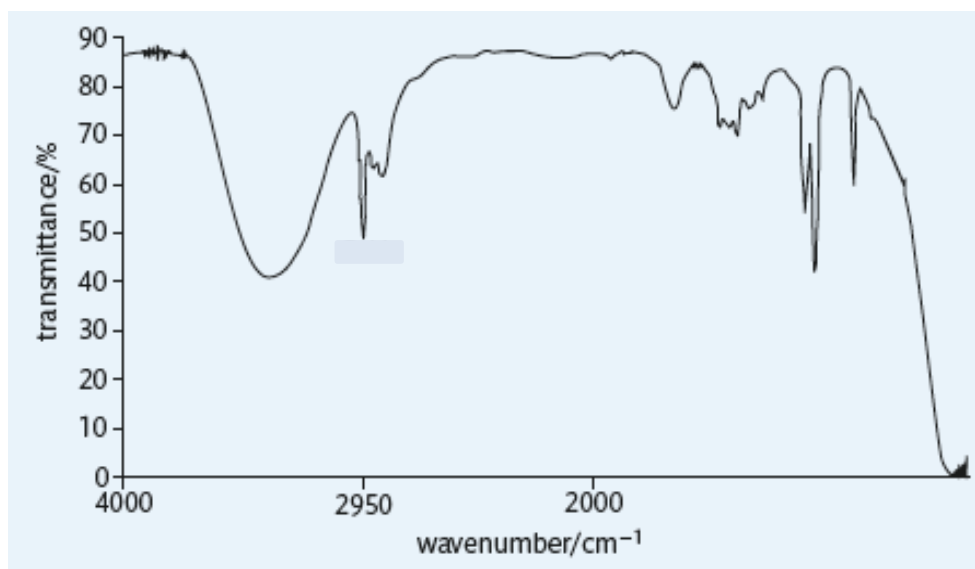
(C1)

- The ${}^{90}\text{Y}$ isotope has a half-life of 64 hours. Use the relevant equation in Section 1 to calculate how much of a 65.0 g sample would remain after 4 days.

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(C2)

6. Infrared spectroscopy can be used to detect ethanol in breath samples of “drink drivers”.



- a. Use Section 26 and your knowledge of the structure of ethanol to identify the 2 important peaks on this spectrum.

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(B2)

- b. Explain why one of these peaks will also be present in the breath of people who have not been drinking alcohol.

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(B1)

- c. People who suffer from diabetes often exhale propanone vapour in their breath. Explain why this might give a false positive result for the presence of alcohol?

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(B1)

- d. Describe how acidified potassium dichromate is used to detect ethanol in a breathalyser.

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(A2)

7. The environmental impact of the synthesis, isolation and administration of medications are important to consider. State one problems associated with each of the following:

- a. High-level nuclear waste

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(B1)

- b. The use of antibiotics in animal feed

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(B1)

8. The anti-cancer drug “Taxol” was originally isolated from the bark of Pacific yew trees which take 200 years to grow and are only found in some parts of the US.

a. One current method being researched to synthesize this drug is through fermentation reactions by some fungi. Explain how this current research is related to the principles of “green chemistry”.

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(B2)

b. The most common method of production of Taxol is now enantioselective synthesis using a chiral auxiliary. Briefly explain what a “chiral auxiliary” is and why it is needed in this synthesis. The structure for Taxol is found in the data booklet.

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(A2)